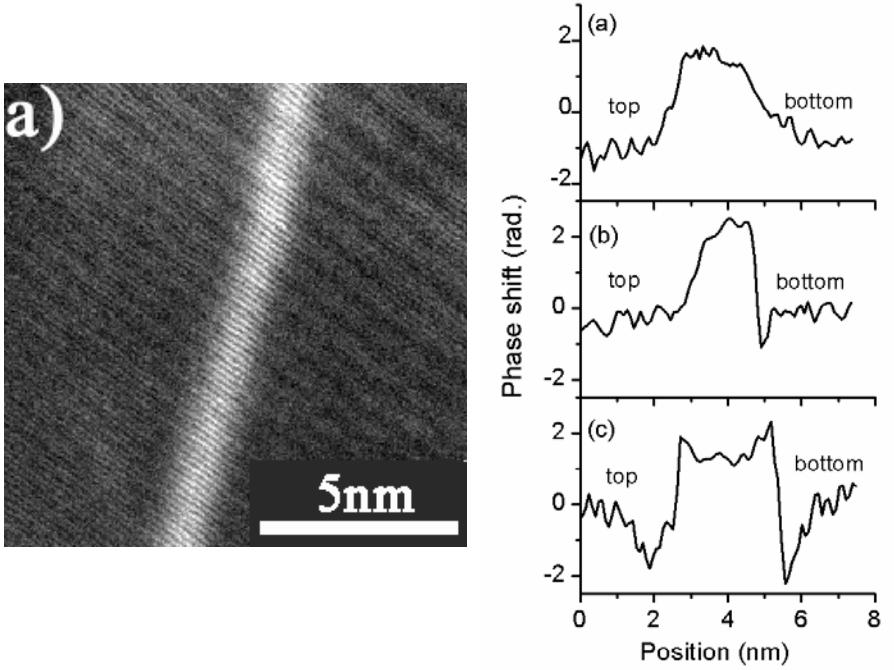
Interface Effects in Magnetic Tunnel Junctions (MTJ)

John Q. Xiao and E. Nowak, University of Delaware, DMR Award 0071878

Magnetic tunnel junctions (MTJ) consisting of two ferromagnetic electrodes separated by an insulating Al_2O_3 barrier are very sensitive magnetic field sensors. Potential applications include magnetic recording heads, nonvolatile random access memory, and bio-sensing chips. The quality of Al_2O_3 barrier is critical in determining the MTJ's performance. We have used high resolution transmission electron microscopy equipped with electron hologram capability to probe the barrier shape profile at atomic scale. The studies allow us to determine structure-property relationship in MTJ, as well as to provide guidelines to optimize the barrier structure.

Appear soon in Appl. Phys. Letts



Left: Electron hologram imagine of a MTJ with an optimally-oxidized Al_3O_4 barrier shown as white band. The phase in the interference pattern can be used to extract barrier shape profile as shown in the right panel where the barrier shape profiles of MTJs with (a) over-, (b) optimally-, and (c) under-oxidized AlO_x barriers are displayed.

Interface Effects in Magnetic Tunnel Junctions

John Q. Xiao and E. Nowak, University of Delaware, DMR Award 0071878

Education:

One undergraduates (Jeremy Johnson) and six graduate students (Lai Jiang, Glen Landry,Paul Scott, John Skovholt, Xiaohai Xiang and Weigang Wang) contributed to this work. Undergraduates Glen receive his Ph.D in 2001 and is presently a postdoc at Naval Research Laboratory. Paul received his MS degree in 2002. Xiaohai is awarded with a competitive fellowship from the University of Delaware from 2003-2004.

Instructional models (e.g. Problem-Based Learning) and materials for undergraduate physics courses have been developed and disseminated to faculty worldwide through an online, peer-reviewed Clearinghouse.

Outreach:

Outreach program to local area high school students has been established to convey the growing presence of magneto-electronics in their future.

We have also established a Speakers Program for reaching out to undergraduate science majors at over 140 mid-Atlantic and northeastern colleges that do not have graduate programs and limited colloquium/seminar series.